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NOTES ON GEOGRAPHIC DISTRIBUTION

New records of reef fishes (Teleostei: Perciformes) in the Rocas Atoll Biological Reserve, off northeastern Brazil

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ABSTRACT: Six new records of reef fish and a hybrid species are reported from Rocas Atoll, off Rio Grande do Norte State, northeast Brazil. Data on species abundance, distribution of the recorded species in Brazilian oceanic islands, trophic structure, and the occurrence of the hybrid species "*Menephorus dubius*" are provided.

Due to their unique characteristics, the Brazilian reefs have a high degree of endemism (Floeter and Gasparini 2000, 2001; Rocha 2003), reaching up to four times the fish endemism rate per area of the Caribbean (Moura 2000). Among the Brazilian oceanic islands, the Rocas Atoll Biological Reserve has the highest percentage of endemic species (8.5%) (Sampaio *et al*. 2006), highlighting it as a priority area for biodiversity conservation.

Despite the high number of new species recently described from Brazilian oceanic islands (e.g., *Scartella itajobi* Rangel and Mendes, 2009, and *Elacatinus phthirophagus* Sazima, Carvalho-Filho and Sazima, 2008, from the Fernando de Noronha Archipelago; and *Elacatinus pridisi* Guimarães, Gasparini and Rocha, 2004, *Sparisoma rocha* Pinheiro, Gasparini and Sazima, 2010, and *Halichoeres rubrovirens* Rocha, Pinheiro and Gasparini, 2010, from the Trindade and Martim Vaz Archipelago), knowledge of Brazilian reef fish fauna remains insufficient. The vast majority of existing information on the species composition of the Brazilian oceanic islands was obtained through scientific expeditions in the 1980s (Lubbock and Edwards 1981) and particularly in the 1990-2000s (Nunan 1992; Floeter and Gasparini 2000; Gasparini and Floeter 2001; Gadig and Sampaio 2002; Feitoza *et al*. 2003; Vaske Júnior *et al*. 2005; Sampaio *et al*. 2006). However, information on the ichthyofauna of Brazilian oceanic islands (Sampaio *et al*. 2006) is still relatively scarce, especially in relation to the Rocas Atoll Biological Reserve, where only three studies have been conducted with intention to survey its species of reef fish (Faria and Silva 1937; Rosa and Moura 1997; Sampaio *et al*. 2006).

The new records of reef fish species in the Rocas Atoll may be attributed to two major factors: 1) tthe difficulty of developing scuba diving based ichthyological studies in situ due to logistical challenges;; and 2) as discussed by Pinheiro *et al*. (2009), the temporal variation in population size, which can reduce the likelihood of registration of a given species during periods of low abundance of its population.

The Rocas Atoll, the only atoll of the South Atlantic Ocean, is located between 03°45' and 3°56' S and 33°37' and 33°56' W (Kikuchi 2002). It was the first biological reserve established in Brazil (Decree-law no. 83549 of July 5, 1978), including the entire top of the seamount to 1000 m depth isobath, with a total area of 362 km^2 (Kikuchi 2002). The Rocas Atoll of carbonate composition mainly formed by fouling organisms, coralline algae, mollusks, corals, tube-building polychaetes, foraminifera, and cemented sediment (Gherardi and Bosence 1999, 2001).

The new occurrences resulted from 233 hours of observation taken inside the Rocas Atoll (194 free dives), from December 2008 to December 2010. Species were identified in the field (*in situ*) and confirmed through photography when necessary;. taxonomic identification and frequencies of observation were based on Humann and Deloach (2003). For characterization of the species occurring in the Brazilian oceanic islands and their geographical distribution, the biogeographical division proposed by Floeter *et al*. (2003) and followed by other authors (Luiz Jr. *et al*. 2008; Pinheiro *et al*. 2009) was applied. The internal sites of Rocas Atoll are named as follows: Abrolhos (AB), Âncoras (A), Barreta Falsa (BF), Barretão e adjacências (BR), Barretinha (B), Cemitério (C), Cemiteriozinho (CZ), Donzelinha (D), Farol 1 (F1), Farol 2 (F2), Garoupinha (G), Mapas (M), Naufrágios (N), Nove (NV), Podes Crê (PC), Porites (P), Próximo aos Nove (PN), Próximo as Âncoras (PA), Rocas (R), Salão (S), Salãozinho (SZ), Tartarugas (T), and Zulú (Z) (Figure 1).

During the study period, six species of reef fishes and a hybrid species were reported for the first time in the Rocas Atoll (Table 1), belonging to five families: Gobiidae, with two species, and Chaetodontidae, Labridae, Pomacanthidae, and Labrisomidae with one species each. Two of these species, *Elacatinus phthirophagus* and *Labrisomus conditus*, were considered endemic to the Fernando de

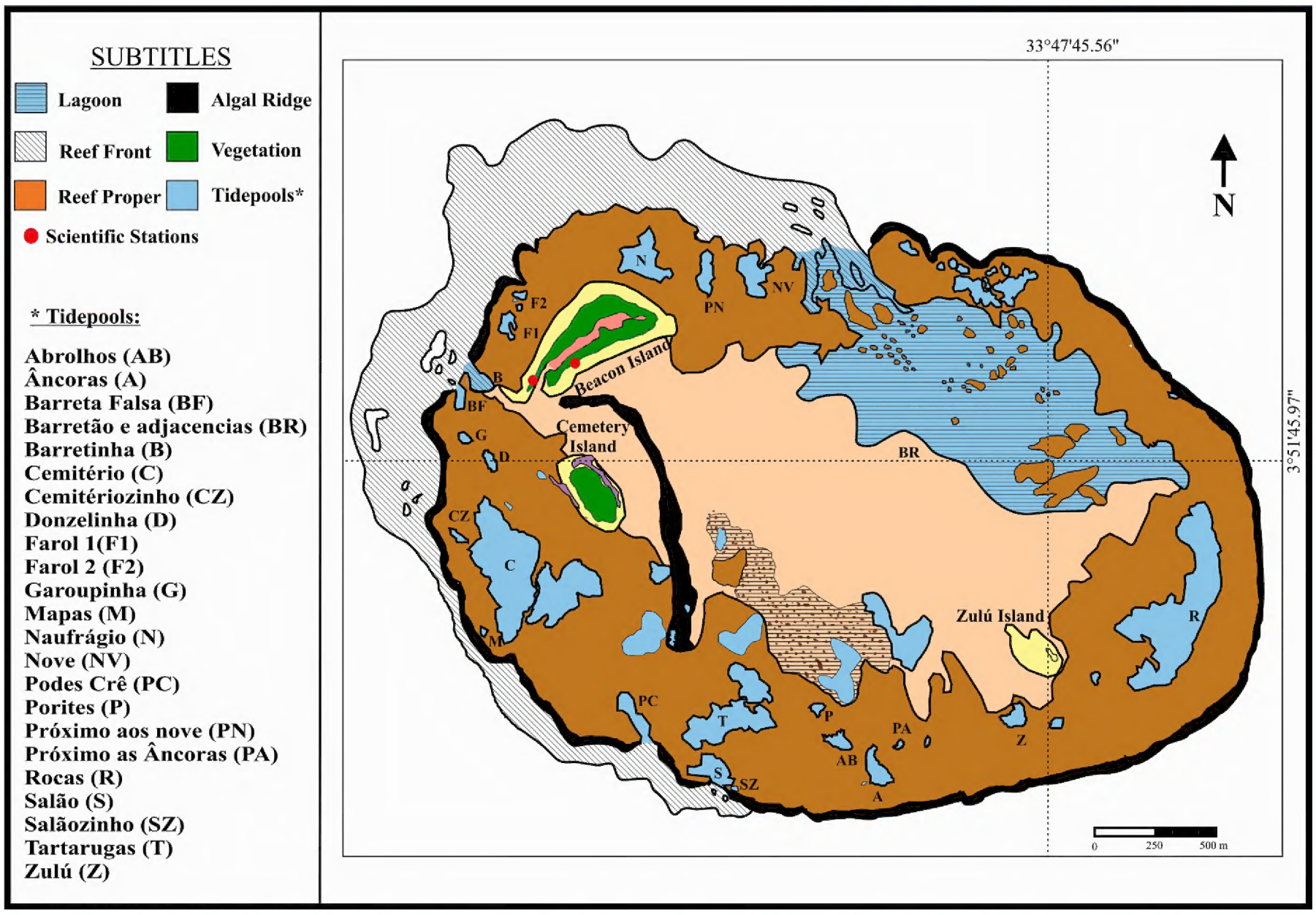

FIGURE 1. Schematic map showing the features and dive sites of the Rocas Atoll, off northeastern Brazil. Modified from Pereira *et al.* (2010).

Noronha Archipelago until the present work. The first species, *Elacatinus phthirophagus* (Gobiidae) (Figure 2B), was observed alone or in pairs, usually associated with the scleractinian coral *Montastrea cavernosa,* and measured between 1 and 4 cm. Specimens of *Labrisomus conditus* (Figure 2C) were observed alone in the surf zone or near the wall of the reef using dens and crevices for shelter; their length ranged between 10 and 15 cm.

The hybrid "*Menephorus dubius*" Poey, 1860, resulting from the crossing between *Cephalopholis fulva* (Linnaeus, 1758) and *Cephalopholis furcifer* (Linneaus, 1758) (Figure 2A), was recorded in the inner area of the atoll between July and December 2010. Several specimens, measuring from 15 to 25 cm, were observed in relatively shallow areas between 1 and 4 m depth, alone or in pairs, swimming near the reef wall, using the crevices for shelter.

Two specimens of *Centropyge aurantonotus* Burgess, 1974 (Pomacanthidae) (Figure 2F and 2H) were observed on the reef top in shallow water between 0.5 and 1 m depth. *Centropyge aurantonotus* has a preference for deeper waters, between 15 and 200 m (Humann and Deloach 2003), but are most commonly observed between 15 and 25 m. This omnivorous species is considered to be territorial, living alone or in pairs.

One banded butterflyfish specimen, *Chaetodon striatus* (Linnaeus, 1758) (Figure 2D), was also observed alone near the reef wall, using cracks in the reef as a refuge. This species is commonly found in rocky and coral environments, between 1 and 90 m depth, from the coast to oceanic islands (Floeter *et al.* 2003).

A species of Labridae, *Xyrichthys novacula* (Linnaeus, 1758) (Figure 2E), was also observed in the Rocas Atoll during the study period. It is a common species in clear and shallow waters, living next to reefs and rocky shores most often between 1 and 2 m depths (Garcia Junior *et al.* 2010). A single specimen was observed in a sandy bottom at about 1.5 to 2 m depth.

Specimens of *Ctenogobius saepepallens* (Gilbert and Randall, 1968) (Figure 2G) were observed at depths from 1 to 2 m, always alone above the sandy bottom near their hole. Body size of observed specimens ranged from 2 to 4 cm.

The species herein recorded are already known to compose the reef fish fauna along the Brazilian coast, but their presence in the Rocas Atoll was not reported until now. Two species, *Ctenogobius saepepallens* and *Xyrichthys novacula*, had no records from other Brazilian oceanic islands. *Ctenogobius saepepallens* occurs from the northeastern to the southern coast of Brazil, with records on the coasts of Rio Grande do Norte (Garcia Junior *et al.* 2010), São Paulo (Luiz Jr. *et al.* 2008) and Santa Catarina, its southernmost distribution limit (Barneche *et al.* 2009). Likewise, *Xyrichthys novacula* occurs from the coast of Rio Grande do Norte to Santa Catarina (Garcia Junior *et al.* 2010; Barneche *et al.* 2009). Rare species and/or species of occasional occurrence, such as *C. fulva* and *C. furcifer* hybrid, "*Menephorus dubius*" (see Smith 1966; Bostrom *et al.* 2002), were also observed in other oceanic islands of the Brazilian province. The first occurrences of this hybrid species in Brazilian waters were reported from the Fernando de Noronha "hotspot" (Pinheiro *et al.* 2009). Specimens were also caught in the vicinity of the oceanic islands of the Trindade (Pinheiro *et al.* 2009) and around São Pedro e São Paulo Archipelago (Bruno Cesar de Macena Rocha, pers. obs.).

According to Serafini *et al.* (2010) and Sampaio *et al.* (2006), the reef fish fauna of the Brazilian oceanic islands can be considered rich in both number of species and in

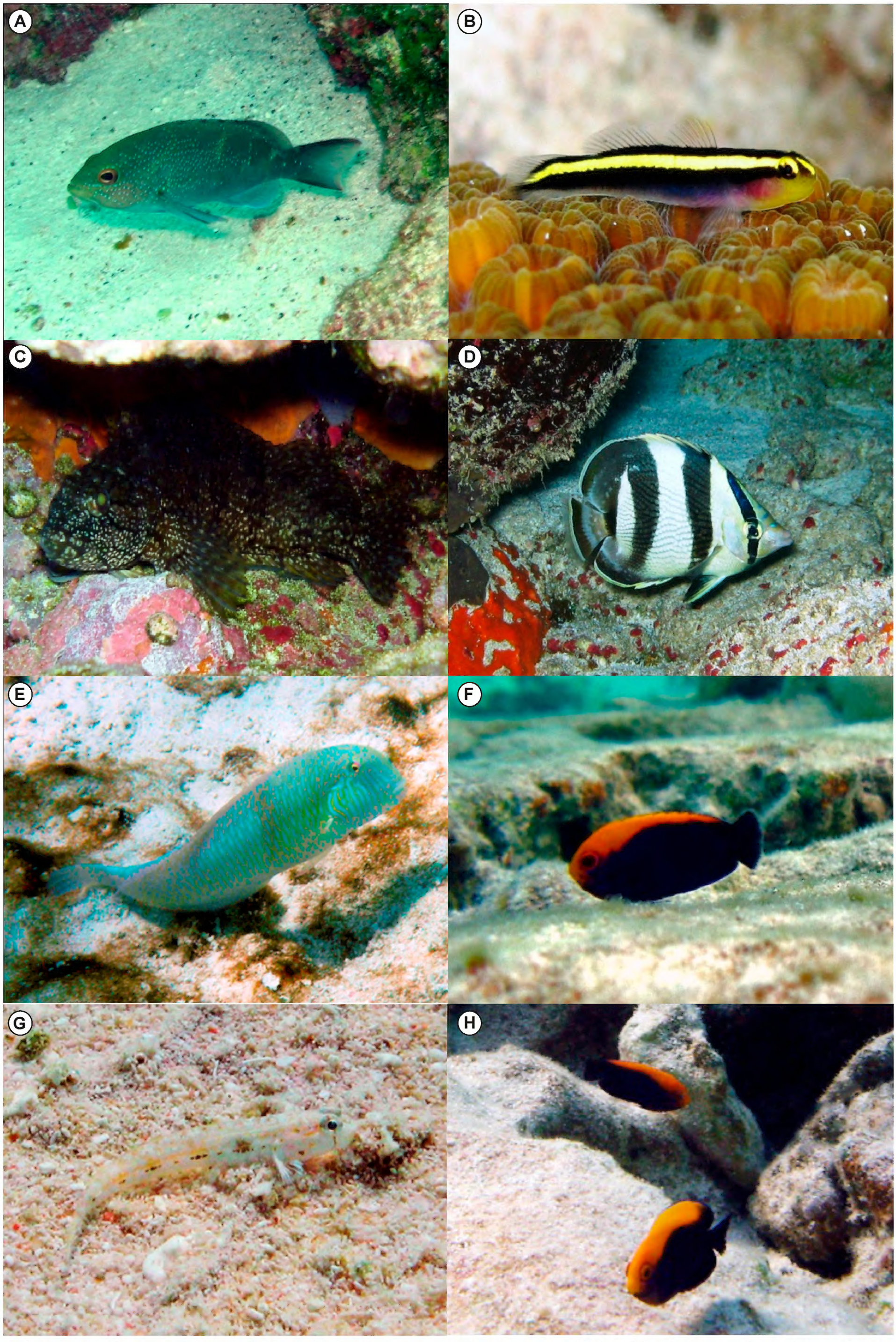

Figure 2. New records of reef fishes in the Rocas Atoll, off northeastern Brazil, between 2008 and 2010. A) *Menephorus dubius*; B) *Elacatinus phthirophagus*; C) *Labrisomus conditus*; D) *Chaetodon striatus*; E) *Xyrichthys novacula*; F and H) *Centropyge aurantonotus*; and G) *Ctenogobius saepepallens*. Photos by Dráusio Veras (A, B, D, G), Yuri Marins (E), Risonaldo Pereira Dantas (F, H), and Diogo Oliveira (C).

endemism rate. The great similarity between the fish fauna of the Fernando de Noronha Archipelago and the Rocas Atoll is likely due to the presence of shallow oceanic banks between these formations, serving as links between them (Sampaio *et al.* 2004). These areas share the same number of endemic species (Sampaio *et al.* 2006), and Rocha (2003) considers this insular group as a single biogeographic unit. When compared to other island ecosystems, Rocas Atoll has low habitat diversity and a high level of endemism, making it an important area for marine conservation in Brazil (Rocha 2003).

Meanwhile, Brazilian oceanic islands have low levels of endemism when compared to other islands of the Atlantic (Floeter and Gasparini 2001). This can be probably explained by the small, but stable, connectivity of seamounts and banks from the continental margin that feeds the Brazilian oceanic islands (Sampaio *et al*. 2006). Moreover, sea currents enable larval dispersal of many fish species from the coast to oceanic islands, since the larval development of many fish species takes longer than the time required for oceanic currents to reach oceanic islands (e.g. *Acanthurus* have larval stages ranging between 42 and 71 days; Rocha *et al.* 2002). This allows the reef fish species commonly found in continental margin to be also found in oceanic islands. For example, *Chaetodon striatus* is typically found in reefs of coastal margin, but has been observed in the Rocas Atoll (present study). Juveniles of *Stegastes rocasensis,* endemic to the Rocas Atoll and Fernando de Noronha Archipelago, have been found in São Pedro e São Paulo Archipelago (Feitoza *et al*. 2003; Sampaio *et al*. 2006).

Reef fishes, particularly the endemics, are commonly sedentary (Floeter and Gasparini 2000, Moura and Sazima 2000, Floeter *et al.* 2001) and therefore subject to several types of threats, such as the introduction of exotic species that might prey on or compete with them, or habitat degradation caused by physical changes such as climate change (Sampaio *et al.*2006).

According to Roberts *et al.* (2003), vulnerable marine habitats that have low resilience, like coral reefs environments, should be protected with utmost urgency. Given this context, it is extremely important that the ecological connectivity within and between reefs, as well as between the reefs and other systems, be protected as well, so that the resilience of these environments may be maintained (McCook *et al.*2009).

The new records presented here show that there is still a wide gap in the existing information on the composition and community structure of reef fish associated with the Brazilian oceanic islands, as well as in the understanding of the connectivity and settlement processes among the islands and between the mainland.

The Rocas Atoll and the Fernando de Noronha Archipelago share the same endemic species due to their connectivity, as well as some endangered species such as *Ginglymostoma cirratum* (Bonnaterre, 1788) and *Epinephelus itajara* (Lichtenstein, 1822). Therefore, information on the composition and distribution of the species present in these ecosystems is extremely important for the development of effective management and conservation strategies of fish and their essential habitats.

Table 1. New records of reef fishes in Rocas Atoll, Brazil. Abundance in the study area: CO, common; OC, occasional (sightings are not expected, unusual on a regular basis); UN, uncommon (sightings are expected, unusual); RA, rare (exceptional sightings). Occurrence in Brazilian Oceanic Islands: RA, Rocas Atoll; FN, Fernando de Noronha; TR, Trindade; SS, São Pedro e São Paulo Archipelago; AB, Abrolhos complex. Sites in Rocas Atoll: A, Âncoras; AB, Abrolhos; B, Barretinha; BF, Barreta Falsa; C, Cemitério; D, Donzelinha; G, Garoupinha; M, Mapas; R, Rocas; T, Tartarugas.

FAMILY / SPECIES	ABUNDANCE	OCCURRENCE IN BRAZILIAN OCEANIC ISLAND	SITE	DEPTH (M)	VOUCHER
EPINEPHELIDAE (hybrid species)					
Menephorus dubius	OC	FN; RA; SS; TR	A; C; BF; R	1-4	Figure 2A
CHAETODONTIDAE					
Chaetodon striatus	UN	FN; RA; SS; AB; TR	A	3-4	Figure 2D
POMACANTHIDAE					
Centropyge aurantonotus	RA	FN; RA; AB; TR	B	0,5-1	Figure 2F, 2H
LABRIDAE					
Xyrichthys novacula	RA	RA; AB; TR	T	1-2	Figure 2E
LABRISOMIDAE					
Labrisomus conditus	OC	FN; RA	BF; M	1-2	Fig.ure2C
GOBIIDAE					
Ctenogobius saepepallens	OC	RA	C; D	1-2	Figure 2G
Elacatinus phthirophagus	CO	FN; RA	A; AB; M; C; D; G; R	1-4	Figure 2B

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